A POST-PROCESSING TECHNIQUE APPLIED TO ERROR ESTIMATION OF FEM APPROXIMATIONS OF HELMHOLTZ EQUATION

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One of the main concerns in acoustic finite element analysis is the adequacy of the finite element mesh. Acousticians often use the, so-called, "rule of the thumb" [1] which prescribes a relation between the minimal number of elements and the wave number. This rule only takes into account the capacity of the interpolation given by a specific mesh and is not based on stability aspects. Therefore, as it is well documented in the literature [1], one can obtain very bad results even when the finite element mesh obeys this rule.

Adaptivity is recognized as a major step towards the consolidation of numerical analyzes as a reliable tool for scientific or technological goals . Broadly speaking, it is constituted of two sequential main stages: error evaluation and actions to decrease the error level. In the finite element context, these stages are given by error estimation followed by a remeshing strategy [2]. Posteriori error estimators have become very popular in finite element adaptivity analysis, however, the estimation with application on acoustic finite element formulation seems little explored. A very often used approach to carry out this estimation is a recovery strategy, in which one computes the difference between the gradient of the finite element solution and a recovered gradient based on residuals or in the smoothing of the solution.

This article presents an extension for the acoustics problem of the macroelement post-processing technique, presented in [3], where the derivatives are recovered by solving local variational problems involving the residuals of the balance equation, the irrotational condition and a state relation at specific points , where superconvergence is likely to occur. A number of comprehensive simulation is presented in order to access the main features of the proposed methodology. The post-processing method is tested in specific conditions and the error estimator based on this technique has presented a good performance.

References

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